Supplemental Data for:
Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine aroma compounds. Impacts of harvest technologies. Am J Enol Vitic 73:134-146. doi: 10.5344/ajev.2022.22006

Supplemental Table 1 Effect of harvest technology on Ontario Cabernet franc aroma compounds, 2017. Concentrations are in µg/L unless otherwise specified.

Esters												
Harvest technology[a]	**Ethyl isobutyrate**	**Ethyl hexanoate**	**Ethyl heptanoate**	**Ethyl octanoate**	**Ethyl nonanoate**	**Ethyl decanoate**	**Isobutyl acetate**	**Isoamyl acetate**	**Hexyl acetate**	**Phenylethyl acetate**	**Isoamyl hexanoate**	
HH	492.55 b[b]	968.00 a	8.37	625.26	2.05 b	176.71	90.80	1353.16	15.66	75.30	1.220 a	
MECH	499.07 ab	549.74 b	5.78	296.96	8.76 a	81.34	75.76	856.86	6.18	40.62	0.345 b	
MECH+BLR	457.82 b	540.38 b	10.02	387.16	10.37 a	104.27	68.49	914.09	4.17	41.60	0.487 b	
OPTI	964.47 a	962.96 a	7.51	609.76	10.49 a	163.91	96.06	1439.53	10.58	59.10	0.533 b	
MECH+OS	862.76 ab	782.29 ab	7.17	483.12	11.86 a	138.74	111.45	1249.56	9.34	67.09	0.545 b	
Pr > F	0.019	0.042	0.251	0.143	<0.0001	0.137	0.191	0.127	0.069	0.128	0.002	
Significance	*[c]	*	NS	NS	****	NS	NS	NS	NS	NS	**	
Alcohols, norisoprenoids, and miscellaneous compounds												
Harvest technology	**Isobutanol (mg/L)**	**Isoamyl alcohol (mg/L)**	**Hexanol**	**Heptanol**	**Octanol**	**Phenylethyl alcohol (mg/L)**	**Diethyl succinate**	**β-Damascenone**	**α-Ionone**	**β-Ionone**	**Methyl salicylate**	**Ethyl salicylate**
HH	534.82	1444.51	8511.55	160.53	44.47	183.69	21 333.77	21.66	0.767 a	0.603 a	33.42	1.257
MECH	707.72	1410.76	8109.69	124.74	31.69	145.42	22 558.73	10.56	0.490 b	0.315 a	22.00	0.850
MECH+BLR	601.57	1420.48	8047.78	216.39	43.54	164.97	27 466.93	10.47	0.523 b	0.333 a	26.25	1.517
OPTI	806.55	1740.67	9417.07	163.29	39.98	173.13	27 244.50	19.56	0.830 a	0.440 a	20.83	0.593
MECH+OS	934.52	1687.57	11 591.44	169.89	42.63	196.54	29 029.69	17.49	0.785 a	0.525 a	23.70	0.790
Pr > F	0.306	0.596	0.112	0.114	0.672	0.559	0.653	0.069	0.036	0.070	0.628	0.287
Significance	NS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS	NS
Terpenes												
Harvest technology	**Linalool**	***cis*-Linalool oxide**	***trans*-Linalool oxide**	**Geraniol**	**Nerol**	**Nerolidol**	**Nerol oxide**	**Citronellol**	**α-Citral**	**β-Citral**	***cis*-Rose oxide**	***trans*-Rose oxide**
HH	10.63	3.00 c	0.517 c	43.67	7.58	0.593	0.307	14.95	4.23	0.000 b	0.267 b	0.040 b
MECH	5.22	3.36 c	16.89 ab	20.03	3.89	0.305	0.315	6.44	1.89	0.530 b	0.285 b	0.095 ab
MECH+BLR	7.45	14.97 a	22.01 ab	25.60	4.89	0.290	0.440	7.74	2.96	1.543 a	0.560 a	0.147 a
OPTI	9.45	5.45 bc	25.89 a	25.51	3.96	0.117	0.293	9.91	2.49	0.000 b	0.157 b	0.043 b
MECH+OS	8.50	8.18 b	12.99 bc	30.89	5.44	0.315	0.430	11.26	3.22	0.635 ab	0.245 b	0.080 ab
Pr > F	0.105	< 0.0001	<0.0001	0.260	0.644	0.434	0.153	0.117	0.242	0.002	0.002	0.020
Significance	NS	****	****	NS	NS	NS	NS	NS	NS	**	**	*
Harvest technology	**α-Terpineol**	**Terpinolene**	**γ-Terpinene**	**Limonene**	**Myrcene**	**Eugenol**						
HH	20.79	0.120	0.020	0.513	1.11	4.49						
MECH	17.23	0.085	0.000	0.420	1.22	2.76						
MECH+BLR	21.91	0.093	0.010	0.473	1.78	4.16						
OPTI	20.53	0.127	0.043	0.627	2.34	3.16						
MECH+OS	21.89	0.115	0.010	0.475	2.43	3.89						
Pr > F	0.782	0.349	0.205	0.617	0.445	0.232						
Significance	NS	NS	NS	NS	NS	NS						

[a]HH, hand harvest; MECH, mechanical harvest; MECH+BLR, mechanical harvest plus preharvest full canopy leaf removal; OPTI, mechanically harvested using a Braud-New Holland optical sorting harvester; MECH+OS, mechanical harvest plus in-winery optical sorting.
[b]Means followed by different letters are significantly different at $p < 0.05$, Duncan's multiple range test.
[c]*, **, ****, NS: significant at $p < 0.05$, 0.01, 0.0001, or not significant, respectively.

Supplemental Data for:
Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine aroma compounds. Impacts of harvest technologies. Am J Enol Vitic 73:134-146. doi: 10.5344/ajev.2022.22006

Supplemental Table 2 Effect of harvest technology on Ontario Cabernet franc aroma compounds, 2018. Concentrations are in µg/L unless otherwise specified.

Esters											
Harvest technology[a]	**Ethyl isobutyrate**	**Ethyl hexanoate**	**Ethyl heptanoate**	**Ethyl octanoate**	**Ethyl nonanoate**	**Ethyl decanoate**	**Isobutyl acetate**	**Isoamyl acetate**	**Hexyl acetate**	**Phenylethyl acetate**	**Isoamyl hexanoate**
HH	161.80	282.88	7.24	187.68	2.05	42.66	322.67 a[b]	802.95	2.51	42.98	0.420 ab
MECH	135.59	289.02	7.42	187.64	2.42	42.31	181.07 ab	708.40	3.19	38.42	0.383 ab
MECH+BLR	113.20	256.25	5.89	179.78	1.63	43.39	147.89 b	560.57	2.37	30.21	0.347 ab
OPTI	214.76	334.20	7.22	217.88	2.83	47.08	181.39 ab	832.65	3.18	44.47	0.597 a
Gregoire	107.88	241.03	6.31	165.90	1.81	43.77	140.27 b	503.50	2.10	26.80	0.277 b
Pr > F	0.338	0.322	0.593	0.530	0.555	0.970	0.029	0.107	0.117	0.146	0.023
Significance	NS[c]	NS	NS	NS	NS	NS	*	NS	NS	NS	*

Alcohols, norisoprenoids, and miscellaneous compounds												
Harvest technology	**Isobutanol (mg/L)**	**Isoamyl alcohol (mg/L)**	**Hexanol**	**Heptanol**	**Octanol**	**Phenylethyl alcohol (mg/L)**	**Diethyl succinate**	**β-Damascenone**	**α-Ionone**	**β-Ionone**	**Methyl salicylate**	**Ethyl salicylate**
HH	256.55	304.37	1793.98	168.42	36.58	53.73	6757.91	5.64 b	0.675	0.305	2.47	0.390 b
MECH	159.86	266.06	2182.39	178.25	45.51	46.53	12 839.44	7.37 ab	0.950	0.277	8.54	1.28 a
MECH+BLR	127.20	216.23	1608.69	133.84	32.44	37.52	9942.42	6.70 ab	0.603	0.270	6.42	1.18 a
OPTI	173.21	310.74	2398.27	167.37	55.91	57.99	12 221.67	11.42 a	0.967	0.180	18.35	0.400 b
Gregoire	135.06	215.32	1685.06	154.60	31.64	38.02	10 212.02	6.03 ab	0.477	0.287	2.43	0.350 b
Pr > F	0.138	0.513	0.571	0.890	0.214	0.376	0.322	0.036	0.055	0.114	0.419	< 0.0001
Significance	NS	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	****

Terpenes and methoxypyrazines												
Harvest technology	**Linalool**	***cis*-Linalool oxide**	***trans*-Linalool oxide**	**Geraniol**	**Nerol**	**Nerolidol**	**Nerol oxide**	**Citronellol**	**α-Citral**	**β-Citral**	***cis*-Rose oxide**	***trans*-Rose oxide**
HH	1.06	1.47	0.410	14.94	7.92 ab	0.245	0.220	2.78 c	1.93	3.63	0.185 b	0.065 b
MECH	1.29	5.29	1.67	14.88	13.83 a	0.297	0.303	15.51 a	3.23	4.19	0.437 a	0.153 a
MECH+BLR	1.14	4.56	1.36	11.81	10.51 ab	0.267	0.227	14.08 ab	2.57	3.52	0.383 ab	0.140 ab
OPTI	1.25	2.07	10.21	10.69	9.93 ab	0.380	0.310	12.07 ab	3.58	4.32	0.290 ab	0.100 ab
Gregoire	0.540	1.84	0.557	6.49	5.78 b	0.200	0.157	7.24 bc	2.68	3.55	0.220 b	0.080 b
Pr > F	0.100	0.089	0.511	0.057	0.050	0.154	0.213	0.006	0.175	0.770	0.009	0.015
Significance	NS	NS	NS	NS	*	NS	NS	**	NS	NS	**	*

Harvest technology	**α-Terpineol**	**Terpinolene**	**γ-Terpinene**	**Limonene**	**Myrcene**	**Eugenol**	**IPMP[d] (ng/L)**	**IBMP[d] (ng/L)**	**SBMP[d] (ng/L)**
HH	19.93	0.015	0.010	0.085	2.52	0.125 b	2.65 a	3.35	1.25
MECH	19.28	0.010	0.010	0.107	1.30	2.74 a	1.27 b	2.93	2.40
MECH+BLR	13.46	0.017	0.010	0.107	2.05	3.31 a	1.63 b	3.03	1.40
OPTI	17.99	0.017	0.007	0.160	1.87	1.21 ab	1.80 b	2.37	1.30
Gregoire	8.88	0.010	0.000	0.060	0.950	0.480 b	1.30 b	3.17	1.43
Pr > F	0.286	0.234	0.204	0.082	0.198	0.004	0.017	0.392	0.226
Significance	NS	NS	NS	NS	NS	**	*	NS	NS

[a]HH, hand harvest; MECH, mechanical harvest; MECH+BLR, mechanical harvest plus preharvest full canopy leaf removal; OPTI, mechanically harvested using a Braud-New Holland optical sorting harvester; Gregoire, mechanical harvest with Gregoire GL8 with optical sorting.
[b]Means followed by different letters are significantly different at $p < 0.05$, Duncan's multiple range test.
[c]*, **, ****, NS: significant at $p < 0.05$, 0.01, 0.0001, or not significant, respectively.
[d]IPMP, isopropyl methoxypyrazine; IBMP, isobutyl methoxypyrazine; SBMP, *sec*-butyl methoxypyrazine.

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine aroma compounds. Impacts of harvest technologies. Am J Enol Vitic 73:134-146. doi: 10.5344/ajev.2022.22006

Supplemental Table 3 Effect of harvest technology on Ontario Cabernet franc aroma compounds, 2019. Concentrations are in µg/L unless otherwise specified.

Esters

Harvest technology[a]	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate
HH	452.82 a[b]	1538.83 a	11.01 abc	402.49 ab	3.15 a	62.38 ab	496.62 ab	2480.06 a	3.88 b	60.17 b	1.49 ab
MECH	314.74 bcd	1369.95 a	11.79 ab	450.06 a	1.31 c	92.28 ab	413.02 bc	2025.51 ab	4.06 b	46.02 bc	1.81 a
MECH+BLR	278.72 cd	1300.38 a	12.75 a	368.69 ab	2.45 ab	51.22 ab	391.00 c	2173.92 ab	4.37 b	49.95 bc	1.37 ab
OPTI	354.79 bc	1336.51 a	8.30 bc	373.83 ab	1.47 c	69.56 ab	429.91 bc	1900.31 b	4.10 b	42.85 c	1.61 ab
Gregoire	387.39 ab	1351.86 a	13.68 a	400.97 ab	2.87 ab	96.86 a	476.70 abc	2228.60 ab	4.16 b	50.53 bc	1.69 a
MECH + OS	266.03 d	924.09 b	7.128 c	222.79 b	2.18 bc	34.74 b	550.85 a	2520.69 a	8.45 a	103.97 a	0.916 b
Pr > F	<0.0001	<0.0001	0.001	0.044	<0.0001	0.041	0.001	0.012	<0.0001	<0.0001	0.030
Significance	****[c]	****	***	*	****	*	***	*	****	****	*

Alcohols, norisoprenoids, and miscellaneous compounds

Harvest technology	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
HH	739.66	2742.82	11 168.75	262.87	120.04	147.86	4399.54 d	14.38	1.68 a	0.418	13.99 ab	0.388 bc
MECH	623.31	2168.01	10 882.6	286.86	104.52	108.46	25 668.81 ab	14.58	1.58 ab	0.417	16.47 a	0.506 ab
MECH+BLR	593.28	2162.00	10 748.53	322.36	113.88	123.36	24 258.58 ab	12.12	1.38 b	0.387	13.66 ab	0.561 a
OPTI	840.78	2682.74	14 031.77	247.47	88.17	121.23	18 963.25 bc	11.58	1.11 c	0.338	10.21 c	0.257 de
Gregoire	833.08	2681.06	12 297.01	329.78	117.65	131.75	30 929.99 a	12.36	1.64 a	0.407	12.39 bc	0.275 cd
MECH + OS	593.49	2127.57	13 932.05	292.10	128.13	192.85	13 878.61 c	12.43	0.832 d	0.339	6.72 d	0.137 e
Pr > F	0.182	0.240	0.232	0.130	0.080	0.097	<0.0001	0.098	<0.0001	0.192	<0.0001	<0.0001
Significance	NS	NS	NS	NS	NS	NS	****	NS	****	NS	****	****

Terpenes

Harvest technology	Linalool	*cis*-Linalool oxide	*trans*-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	*cis*-Rose oxide	*trans*-Rose oxide
HH	8.71 a	13.28 a	6.76	26.10	13.01 b	0.262	0.307 bc	17.14 a	4.13 a	3.31	0.276 b	0.066 b
MECH	7.48 abc	12.24 ab	6.35	25.91	22.29 a	0.172	0.417 ab	12.82 b	4.09 ab	2.59	0.434 a	0.107 a
MECH+BLR	7.25 bc	13.44 a	8.76	26.97	13.59 b	0.202	0.449 a	14.13 b	4.16 a	3.53	0.514 a	0.139 a
OPTI	7.23 bc	9.39 b	3.37	25.46	11.40 b	0.116	0.253 c	14.43 ab	2.99 b	2.89	0.195 b	0.052 b
Gregoire	8.01 ab	11.64 ab	3.59	28.02	12.43 b	0.150	0.393 ab	14.75 ab	3.91 ab	2.89	0.247 b	0.055 b
MECH + OS	6.51 c	8.39 b	5.95	23.39	10.84 b	0.160	0.244 c	13.85 b	3.33 ab	3.16	0.219 b	0.049 b
Pr > F	0.002	0.003	0.092	0.548	<0.0001	0.133	<0.0001	0.010	0.012	0.169	<0.0001	<0.0001
Significance	**	**	NS	NS	****	NS	****	**	*	NS	****	****

Harvest technology	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol
HH	85.35 bc	0.025 a	0.020 a	0.120	3.96	2.15 ab
MECH	111.27 a	0.026 b	0.012 b	0.098	2.38	2.17 ab
MECH+BLR	94.86 b	0.033 a	0.011 b	0.198	2.38	2.44 a
OPTI	92.67 b	0.024 b	0.011 b	0.116	1.99	1.72 cd
Gregoire	78.65 cd	0.033 a	0.013 b	0.116	3.23	1.89 bc
MECH + OS	71.19 d	0.027 b	0.010 b	0.087	1.81	1.47 d
Pr > F	<0.0001	0.050	0.002	0.270	0.161	<0.0001
Significance	****	*	**	NS	NS	****

[a]HH, hand harvest; MECH, mechanical harvest; MECH+BLR, mechanical harvest plus preharvest full canopy leaf removal; OPTI, mechanically harvested using a Braud-New Holland optical sorting harvester; Gregoire, mechanical harvest with Gregoire GL8 with optical sorting; MECH + OS, mechanical harvest with in-winery optical sorting.

[b]Means followed by different letters are significantly different at $p < 0.05$, Duncan's multiple range test.

[c]*, **, ***, ****, NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively.

Supplemental Data for:
Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine aroma compounds. Impacts of harvest technologies. Am J Enol Vitic 73:134-146. doi: 10.5344/ajev.2022.22006

Supplemental Table 4 Basic wine composition variables of Ontario Cabernet franc wines with different harvest strategies, 2017 to 2019. TA, titratable acidity.

Vintage	Harvest strategy[a]	pH	TA (g/L)	Color	Total phenols (mg/L)	Anthocyanins (mg/L)	Ethanol (%)
2017	HH (Control)	3.66 ab[b]	6.79 a	0.379 ab	890.07 a	741.42 ab	12.42 ab
	Braud OPTI	3.56 b	6.62 ab	0.425 ab	978.43 a	879.01 a	12.08 b
	MECH+OPTI	3.67 ab	6.33 abc	0.468 a	1349.22 a	947.81 a	12.76 ab
	MECH+BLR	3.74 a	5.89 c	0.295 b	804.87 a	497.78 b	12.99 a
	MECH	3.70 ab	5.99 bc	0.434 ab	937.41 a	627.74 ab	12.63 ab
2018	HH (Control)	4.22 ab	4.44 a	0.066 a	230.69 a	52.83 a	---
	Gregoire	4.24 a	4.35 a	0.097 a	176.23 ab	36.05 ab	---
	Braud OPTI	4.13 b	4.33 a	0.058 a	114.68 c	24.23 b	---
	MECH+BLR	4.28 a	4.04 b	0.072 a	168.34 b	26.41 ab	---
	MECH	4.22 ab	4.36 a	0.111 a	202.12 ab	34.16 ab	---
2019	HH (Control)	3.90 a	6.07 a	0.649 a	1391.99 a	104.43 b	---
	Gregoire	3.81 bc	5.89 ab	0.509 a	1385.68 a	174.42 a	---
	Braud OPTI	3.82 bc	5.71 b	0.539 a	1000.57 a	183.29 a	---
	MECH+OPTI	3.73 d	6.10 a	0.550 a	1395.15 a	178.43 a	---
	MECH+BLR	3.87 ab	5.79 b	0.572 a	1177.34 a	171.10 a	---
	MECH	3.79 cd	5.65 b	0.549 a	1297.29 a	182.01 a	---

[a]HH, hand harvest; Gregoire, mechanical harvest with Gregoire GL8 with optical sorting; Braud OPTI, mechanically harvested using a Braud-New Holland optical sorting harvester; MECH + OPTI, mechanical harvest with in-winery optical sorting; MECH+BLR, mechanical harvest plus preharvest full canopy leaf removal; MECH, mechanical harvest.
[b]Means within years followed by different letters are significantly different at $p < 0.05$, Duncan's multiple range test.

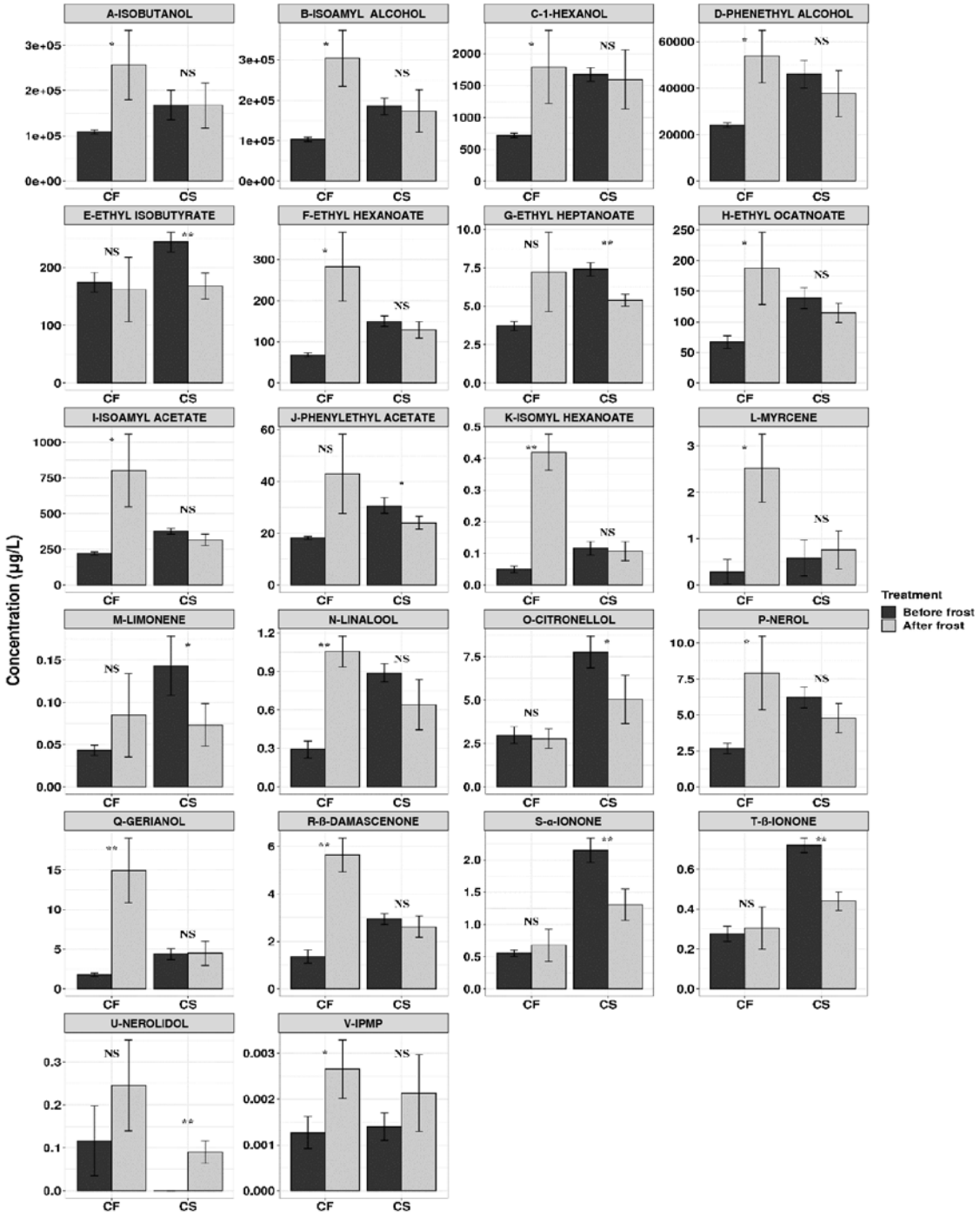
Supplemental Data for:
Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine aroma compounds. Impacts of harvest technologies. Am J Enol Vitic 73:134-146. doi: 10.5344/ajev.2022.22006

Supplemental Table 5 Basic wine composition variables of Ontario Cabernet franc and Cabernet Sauvignon wines with frost treatments, 2018 to 2019. TA, titratable acidity.

Vintage	Cultivar	Treatment	pH	TA (g/L)	Color	Total phenols (mg/L)	Anthocyanins (mg/L)
2018	Cabernet franc	Before frost	4.39	4.30	0.069	235.99	36.35
		After frost	4.22	4.44	0.066	230.77	52.83
		Pr > F	0.045	0.080	0.655	0.919	0.658
		Significance	*[a]	NS	NS	NS	NS
	Cabernet Sauvignon	Before frost	4.11	5.19	0.119	287.03	45.98
		After frost	4.14	5.21	0.086	217.27	37.02
		Pr > F	0.290	0.936	0.231	0.232	0.324
		Significance	NS	NS	NS	NS	NS
2019	Cabernet franc	Before frost	3.80	5.85	0.429	1256.26	156.35
		After frost	3.90	6.07	0.649	1391.99	104.43
		Pr > F	0.105	0.203	0.105	0.472	0.243
		Significance	NS	NS	NS	NS	NS
	Cabernet Sauvignon	Before frost	3.70	6.35	0.778	1606.65	256.01
		After frost	3.79	5.92	0.763	1527.73	266.24
		Pr > F	0.005	0.006	0.493	0.602	0.603
		Significance	**	**	NS	NS	NS

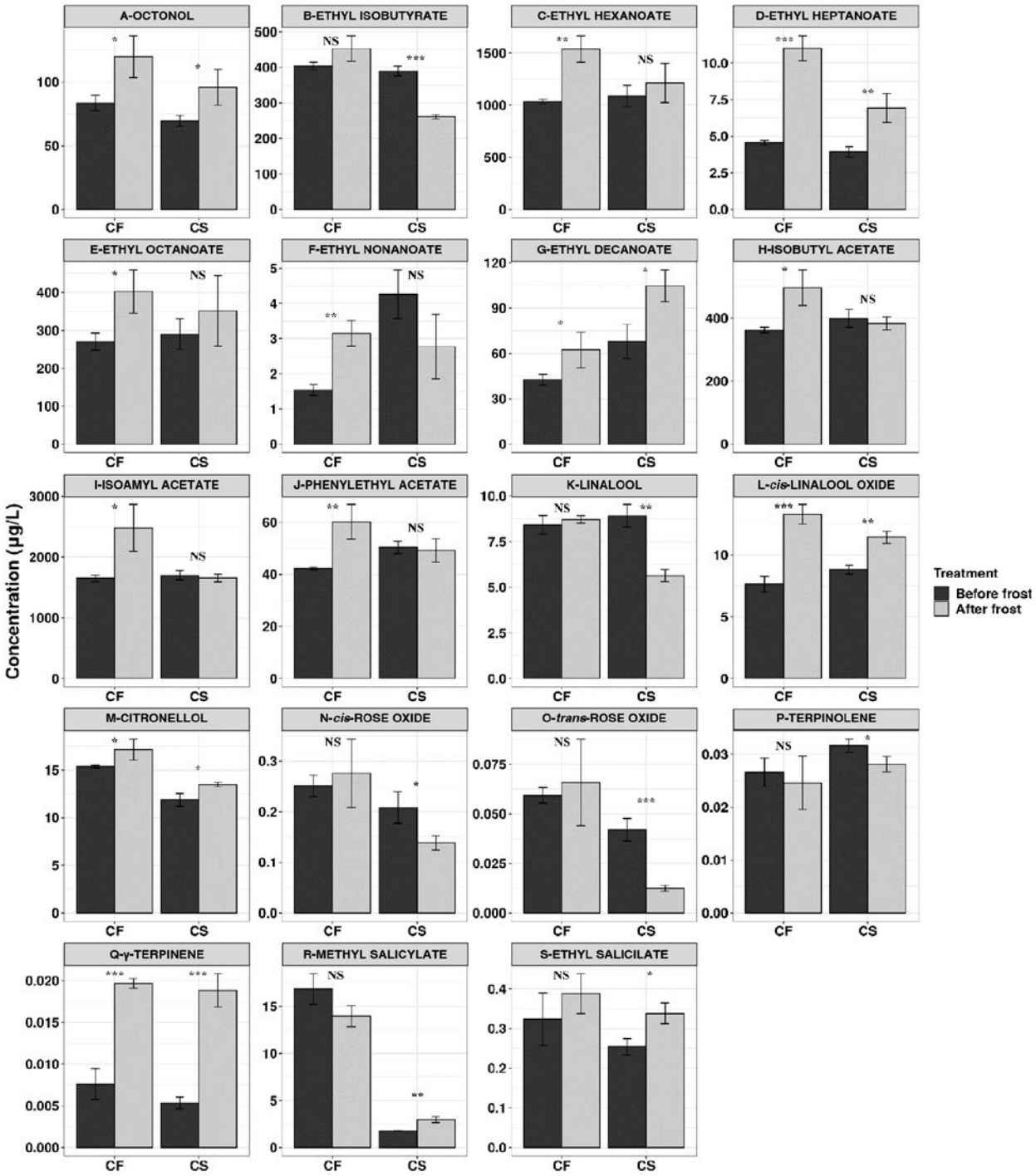
[a]*, **, NS: significant at $p \leq 0.05$, 0.01, or not significant, respectively.

Supplemental Data for:
Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine aroma compounds. Impacts of harvest technologies. Am J Enol Vitic 73:134-146 doi: 10.5344/ajev.2022.22006



Supplemental Figure 1 Effect of killing frost on wine composition of Ontario Cabernet franc (CF) and Cabernet Sauvignon (CS), 2018. IPMP, isopropyl methoxypyrazine. *, **, NS: significant at $p < 0.05$, 0.01, or not significant, respectively.

Supplemental Data for:
Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine aroma compounds. Impacts of harvest technologies. Am J Enol Vitic 73:134-146. doi: 10.5344/ajev.2022.22006



Supplemental Figure 2 Effect of killing frost on wine composition of Ontario Cabernet franc (CF) and Cabernet Sauvignon (CS), 2019. *, **, ***, NS: significant at $p < 0.05$, 0.01, 0.001, or not significant, respectively.